

REVISITING COLIFORM BACTERIA

by Dave Leland

There are now 96 drinking water standards to assure the safety of public drinking water. Of these, microbial contaminants remain the most important priority. Coliform bacteria, our chief indicator of the possible presence of harmful microorganisms, have the highest sampling frequencies and the largest numbers of required samples for public water systems of any drinking water contaminant. Why? Because waterborne disease can and does result from drinking water contaminated with microorganisms. Health effects from pathogenic organisms are acute and immediate. Vulnerable populations are especially at risk including infants, young children, people with impaired immune systems, and some elderly.

It's been a long time since we addressed the issues around coliform bacteria, and there are always people new to the water supply field. And, those of us who have been around a while could use a refresher course. In this issue of the PIPELINE, we focus entirely on coliform bacteria, including their significance in drinking water and the associated regulatory requirements. We review the importance of proper sample collection and documentation, prompt response to coliform bacteria detections, timely notification of water users, and effective corrective action. We also look at the importance of proper well construction and protection of source waters to prevent contamination.

Let's start with a look at an actual recent event in Canada that illustrates what can happen when things go very wrong, and reminds us that our collective goal is safe drinking water!

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REPORTS FINGER SHALLOW WELL AS SOURCE OF WALKERTON OUTBREAK

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Heavy rainfall that washed cattle manure infected with *E.coli* O157:H7 and *Campylobacter* into a shallow well in Walkerton, Ontario, Canada, last May is "believed responsible for the gross contamination" that killed six and sickened an estimated 2,300 residents, concludes a final report by local and federal health officials. The epidemiological report corroborates findings of an Ontario Environment Ministry hydrological report (www.ene.gov.on.ca) which concluded that the suspect #5 well "obtains water from a very shallow, very vulnerable bedrock aquifer which has been shown to be susceptible to contamination by bacteria from the time it was drilled."

Ontario Clean Water Agency officials overseeing the Walkerton, Ontario, water system have shut down well #5 and will plug and abandon it. They have also temporarily stopped using another (#6) of the town's three main supply wells and are installing an

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[More on Walkerton - The December 8 issue of *Waterweek* reports on the ongoing judicial inquiry into the outbreak episode. Canadian media reported testimony from water system staff that they falsely identified locations from which water samples were taken and falsely reported chlorine residual levels, including during the time of the outbreak. The earlier May 2 issue reported that Walkerton water samples showed recurring coliform presence in the months prior to the outbreak, beginning in January. - D. Leland]

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THE COLIFORM RULE - REVISITED

by John Potts

The purpose of the Total Coliform Rule (TCR) is to measure microbial water quality in the distribution system, to detect fecal contamination, and to monitor the effectiveness of water treatment. The rule has been in effect for ten years. Although there have been no changes to the rule since it was adopted in Oregon in 1991, we think it's important to revisit the rule at this time to provide a refresher course on its requirements as well as some general information on coliform bacteria organisms. As a new regulation from the 1986 Amendments to the federal Safe Drinking Water Act, this rule modified maximum contaminant levels (MCLs), sampling requirements, laboratory methods and follow up procedures. As is typical with all rules, there was a period of transition adapting to the many changes and learning new procedures, and this rule was no exception. The content of this article will review each major area of the rule and provide you guidance and assistance to maintain compliance.

What are coliform bacteria?

Coliform bacteria are usually harmless, occur in high densities in the intestinal tract of warm-blooded animals as well as in the natural environment and are easily cultured in relatively simple bacteriological media. The presence of coliform bacteria in drinking water is an important public health concern. They signal possible fecal contamination and hence, the potential presence of pathogens (disease-causing organisms). Most pathogens are difficult (or even impossible) to detect, and they occur sporadically in water. The detection of one pathogen will not necessarily signal the presence of another. The detection of pathogens in water is frequently difficult and cumbersome because of interference by natural competing organisms and specific nutrient requirements of the pathogens. Available pathogen tests are generally used only when there is a strong indication that a waterborne disease outbreak is occurring. Therefore, coliforms are used as **indicators** of microbial quality of drinking.

Lab methods in common use today for routine drinking water testing can detect total coliforms, fecal coliforms and *Escherichia coli* (*E. coli*).

Total Coliforms. Coliform bacteria are a large group of bacteria defined as a gram- negative, aerobic or facultative anaerobic, non-spore forming rods that ferment lactose within 48 hours at 35°C with gas production. Testing for total coliform bacteria is used to determine the microbial quality of drinking water, even though they do not usually cause disease, they are widely distributed in the environment, and are not always associated with the feces of humans and other warm blooded animals.

Fecal coliforms and *E. coli*. Coliforms which are more frequently found in the gastrointestinal tract and feces of warm-blooded animals are known as fecal coliforms. *E.coli* is the predominant specie of coliform bacteria in the large bowel, but some from the *Klebsiella* group also commonly inhabit the intestinal tract. Some species that are detected as fecal coliforms

also inhabit the natural environment. *Klebsiella* has been shown to grow in botanical environments and to inhabit wooden water reservoirs. *Enterobacter* forms a slime layer, and once established in pipeline systems can be quite resistant to chlorine and difficult to remove. *E. coli* is unable to sustain growth in water whereas coliforms of the *Enterobacter*, *Serratia* and *Citrobacter* groups are usually free living organisms in the environment. The various species of coliform bacteria can be identified by testing for the presence or absence of specific enzymes.

The presence of fecal coliforms in water is a strong indicator of fecal contamination and the possible presence of pathogens. Consuming the water may result in acute illness and users should boil water or seek other safe water supplies. However, some of the coliforms discussed above, such as those which grow in wooden tanks and distribution system slime formations, sometimes cause positive fecal coliform tests even if not associated with fecal contamination. The presence of *E. coli* in water samples is clear evidence that fecal contamination has occurred and steps should be taken to avoid consuming the water without taking proper precautions.

Note: The above material was adapted from T.H. Ericksen and Alfred P. Dufour, "Methods to Identify Waterborne Pathogens and Indicator Organisms," *Waterborne Diseases in the United States*, ed. Gunther R. Craun (Boca Raton: CRC Press, 1986), pp 195-200.

Overview of Coliform Requirements

The Total Coliform Rule specifies monitoring of public water supplies for total coliforms, fecal coliforms or *E. coli*. Laboratories generally offer analysis service for all coliform types, and may assist with sampling and reporting of test results. The water suppliers collect samples, submit them to certified labs, report test results to the Division, properly operate and manage their water systems based on those test results, take prompt corrective action and notify the public when problems occur, and ensure that water quality complies with this rule.

Water suppliers should maintain close contact with their laboratories to be sure that all total coliform samples with positive results are tested for fecal coliforms or *E. coli*. They should review procedures to ensure repeat samples are collected promptly after positive routine samples. Quick action to resolve problems has always been important and this rule provides specific follow up procedures to ensure that.

Laboratory methods

Analyses for total coliforms can be conducted using four methods:

- The Multiple Tube Fermentation technique as described in *Standard Methods*, 18th edition.

- The Membrane Filter technique, *Standard Methods*.
- The Presence-Absence test, *Standard Methods*.
- The Chromofluorogenic tests (products marketed as Colilert, Colisure, ColiBlue, Ecolite).

The Chromofluorogenic methods are the most common analytical procedures used by the laboratories for drinking water analyses and the results will be reported as simply total coliform-present or absent and fecal coliforms or *E. coli*, present or absent.

Coliform sampling

It is important to properly identify the type of sample you are collecting as it may affect your compliance with the rule. There is a space on the laboratory form to identify what type of sample you are collecting. The three (3) types of samples are:

- **Routine:** These are samples collected on a routine basis to monitor for coliform contamination. They should be collected according to your coliform sampling plan.
- **Repeat:** These are samples collected following a coliform-present routine sample. The number of repeat samples to be collected is based on the number of routine samples you normally collect.
- **Special:** These samples are collected for reasons other than stated above. Examples would be samples collected after maintenance or repairs to wells, mains or reservoirs and before placing those facilities back into operation, samples collected at a wellhead prior to disinfection, or samples collected from points outside the coliform sampling plan, such as to investigate user complaints. Generally, special samples are those collected from water that is not served. Special samples DO NOT count toward compliance with monitoring requirements and you should not submit these results to us, unless requested.

Routine Coliform Sampling. The number of routine samples and frequency of collection for community public water systems is shown in the table below.

Persons served	Samples per month
up to 1,000	1
1001 - 2,500	2
2,501 - 3,300	3
3,301 - 4,100	4
4,101 - 4,900	5
4,901 and above:	see Table 24 of rules

Noncommunity, nontransient noncommunity, and state regulated public water systems sample at the same frequency as a like-sized community public water system if:

- it has more than 1000 daily population and has ground water as its source, or
- it serves 25 or more daily population and utilizes surface water or ground water under the direct influence of surface water as its source.

Coliform -Top Ten Ways To Do It Right!

Protect your water users' health and avoid violations!

- ✓ Collect samples properly and fill out lab slips completely and accurately.
- ✓ Follow your Coliform Sampling Plan.
- ✓ Get test results to the Division by the 10th day of the following month. Consider having your lab report direct to us on your behalf.
- ✓ Contact the Division or county health department about any coliform-present sample within 24 hours or next business day.
- ✓ Collect repeat samples within 24 hours of notification of a coliform-present result.
- ✓ Take corrective action immediately to eliminate known contamination, verify success with more samples.
- ✓ Immediately notify water users to boil their water if fecal or *E. coli* is confirmed present by repeat sampling. Contact the Division or county health department.
- ✓ Notify users of any violation of the total coliform MCL.
- ✓ Submit a copy of any public notice and evidence of its distribution to the Division or county health department.
- ✓ Collect at least five routine coliform samples during the month following any coliform-present result.

Noncommunity and nontransient noncommunity public water systems with less than 1000 daily population and groundwater sources sample once per quarter.

Test results must be received by the Division no later than the 10th day after the end of the compliance period (month or quarter, as applicable).

Note that the EPA baseline minimum coliform sampling is actually 5 samples per month for all public systems! This is based on statistical analysis that shows that a minimum of 500 milliliters of sample (five 100-ml samples) are needed to assure that coliforms can be detected at a 95% confidence rate in any water system. Fewer samples are allowable only for water systems that are free of sanitary deficiencies as determined by a periodic sanitary survey by the county or the Division, providing additional independent assurance that coliforms are unlikely to occur. Therefore, **whenever**

coliforms do occur in drinking water systems, the requirement for a minimum of five samples per month goes in effect until problems are corrected and the water is demonstrated to be reliably coliform-absent, as discussed in detail below.

If Coliforms Are Present. What do you do when your sample shows the presence of coliforms? First, **you must contact the Health Division Drinking Water Program or your local county health department within 24 hours** or the next business day after the results are reported to you by the laboratory. The Drinking Water Program contracts with many of the local health departments to provide assistance to water systems. The purpose of this requirement is to be sure you assure that you consult with the responsible agency on repeat sampling procedures and possible corrective measures for solving the problem.

Repeat Coliform Sampling. Repeat samples must be collected following a coliform-present routine sample. Repeat samples are intended to confirm or refute the original result, and to more clearly identify the problem area of the system. It is extremely important to initiate repeat sampling immediately as corrective measures can be based on these test results. Whenever a routine sample is total coliform-present, fecal coliform-present, or *E. coli*-present, a set of **repeat samples must be collected within 24 hours** of being notified by your laboratory. The only exception to this is when the Maximum Contaminant Level has been violated for the month or quarter, as discussed below. Your laboratory will make an effort to contact you by telephone so it is extremely important to provide them with your current telephone number.

- If only one routine sample per month or quarter is required, FOUR (4) repeat samples must be collected according to your coliform sampling plan.
- For systems collecting two (2) or more routine samples per month, THREE (3) repeat samples must be collected according to your coliform sampling plan.
- All repeat samples must be collected on the same day.
- Repeat samples must be collected from:
 - The original sampling location of the coliform present sample.
 - Within five (5) service connections upstream from the original sampling location.
 - Within five (5) service connections downstream from the original sampling location.
 - The fourth repeat sample required of small water systems may be collected elsewhere. We recommend that you sample at the well head if your source is untreated ground water, or elsewhere in the distribution system to help further identify the extent of the problem.
 - If the system has only one service connection (e.g., schools, licensed facilities, campgrounds, places of employment, etc.) the repeat samples may be collected from the same sampling point.
- All repeat samples are included in the Maximum Contaminant Level compliance calculation (see below).

The number of required repeat samples is a minimum and meets the intent of the rule, however, there may be instances where you would want to collect more than three or four samples in order to identify a problem area or to continue sampling after corrective measures have been undertaken to be sure the problem is solved.

If you normally collect fewer than five (5) routine samples per month or quarter, and you have a coliform-present sample, **you must also collect a minimum of five (5) routine samples during the following month** regardless of whether an Maximum Contaminant Level violation has occurred. The number of routine samples normally collected counts as part of the five samples.

Maximum Contaminant Levels (MCLs)

There are two types of MCL violations for coliform bacteria. The first is for total coliform and the second is an acute risk to health violation characterized by the confirmed presence of fecal coliforms or *E. coli*.

Total Coliforms. This MCL is based on the presence of total coliforms and compliance is on a monthly or quarterly basis, depending on system type. For systems which collect fewer than 40 samples per month, **no more than one sample may be coliform-present.** In other words, the second coliform-present sample in a month or quarter results in an MCL violation for the system. **Once the MCL is violated, further repeat sampling is not required. Your efforts should focus on notifying the public and correcting the problem.**

For systems which collect more than 40 samples per month, **no more than 5 percent may be coliform-present.** Again, once the MCL is exceeded, no further repeat sampling is required.

All total coliform MCL violations require public notice to your users. (See article on page 7 tier 2 violations).

Fecal Coliforms and *E. coli*. (Acute Risk to Health). An acute risk to human health violation exists if any of the following occur:

- A routine sample is fecal coliform or *E. coli*-present and is followed by a repeat sample which is fecal coliform or *E. coli*-present.
- A routine sample is total coliform-present and is followed by a repeat sample which is fecal coliform or *E. coli*-present.
- A routine sample is fecal coliform or *E. coli*-present and is followed by a repeat analysis which is total coliform-present.
- A routine sample is fecal coliform or *E. coli*-present, but no repeat samples are collected.

An acute health risk violation requires the water system to **immediately advise users to boil their water** (no later than 72 hours). This notice must be distributed via radio and television stations in the area, hand delivered, or posted in conspicuous areas (see article on page 7 tier 1 violations).

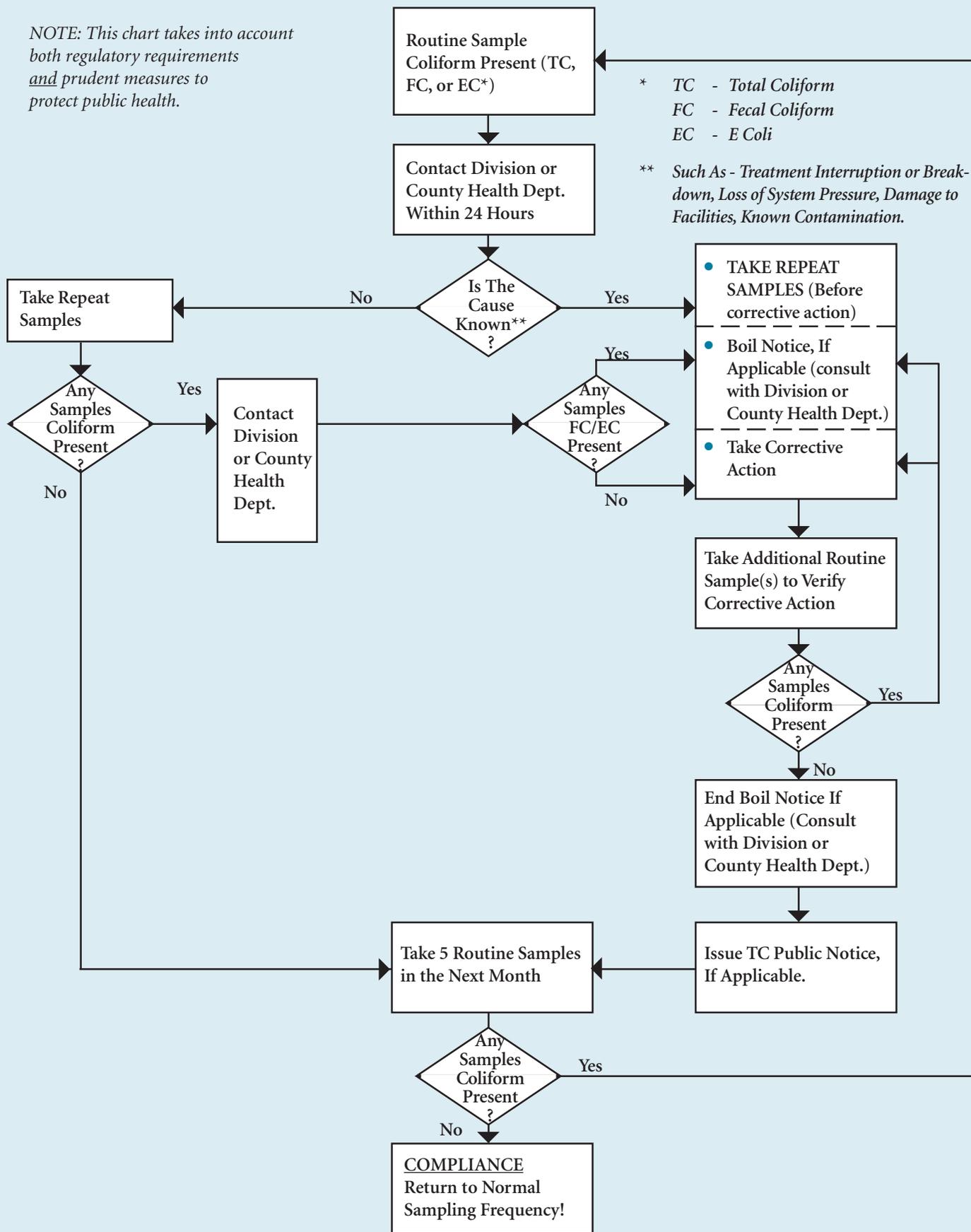
Corrective Action

What do you do after an MCL violation has occurred? First, be sure to consult with the county health department or our office as appropriate. The results of the repeat sampling will give you

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COLIFORM RESPONSE CHART FOR PUBLIC SYSTEMS TAKING LESS THAN FIVE SAMPLES / MONTH

NOTE: This chart takes into account both regulatory requirements and prudent measures to protect public health.



Coliform Rule *(Continued from page 4)*

some information as to where the problem is located in the system. Typical corrective actions include restoring chlorination treatment, increasing the free chlorine residual, or temporarily chlorinating and flushing the distribution system or source facilities. After corrective action is completed, you should conduct more routine sampling to verify that your efforts have been successful. A minimum of one sample should be collected, more if the problem is widespread or the system is large. Even though you will collect at least five routines the following month to verify compliance it is important that the water quality is acceptable in the meantime and to end any boil-water advisory in effect. In addition, you can use the additional routine sample results in communicating with your users about the corrective actions you took.

Coliform Data Reporting

Water systems are required to **report the results of all routine and repeat samples to the Health Division no later than the 10th day of the month following the month (or quarter) in which the samples were collected.** In addition, **you must contact the Health Division or your local health department within one business day to report any coliform positive result.**

We suggest that you report your results to us as soon as you receive them from the laboratory to avoid any unexpected delivery delays.

Many laboratories are now offering sampling services and direct reporting of test results to the Health Division. If you are interested in these services please contact your laboratory to see if they provide them. These services can make sampling and reporting easier for you. We also highly recommend that you sample early in the month or quarter to avoid problems with delays, invalid samples, or anything else that could cause you to miss a test or submit sample results late.

Missing any reporting deadline is a violation that remains on your monitoring history and requires a public notice to your users. Continuing failure to comply with reporting requirements will result in a violation and the potential for enforcement action. You can verify our receipt of your reports by checking our web site and reviewing online data on your water system at www.ohd.hr.state.or.us/dwp.

Coliform Sampling Plan

All public water systems must develop and implement a written coliform sampling plan that addresses three major components. These plans need to be reviewed and approved by the Health Division or county health department during the on-site sanitary survey inspection. The plan should include:

- A brief narrative of the water system that includes source, treatment, storage, distribution system maintenance, pressure zones, chlorine monitoring, number of connections, population, sample site addresses, etc.
- A map of the distribution system with the routine and

repeat sampling sites identified, distribution piping locations, entry points, etc.

- A sample siting plan and maintenance program that includes the minimum number of samples collected, rotation schedule of sample sites (typically 3 sites per routine sample collected each month), contact person and phone number, sampling procedure or protocol, etc.

The sampling sites should be representative of and provide adequate coverage of the distribution network and pressure zones. It is also important to select sampling sites that provide the least amount of negative influence on the water sample. Examples of sites to avoid this would be leaky or dirty faucets, sampling points in areas with little or no water use, swivel faucets, custodial or industrial use sinks or anywhere you believe to be questionable. Many water systems are utilizing dedicated sampling stations in the distribution system that are used only for sampling purposes, eliminating many outside influences potentially affecting water samples. If, when you go to collect your routine sample, you find the water tap has been damaged or is leaking, use one of your alternate sites until you can repair the original. Likewise, if the sample bottle is damaged or you contaminate it, do not use that bottle. Select a clean one for your sample and return the other to the lab empty.

Invalidation of Sample Results

Laboratories must invalidate samples under the following circumstances:

- Any coliform-absent sample when heterotrophic bacteria interferes with analysis.
- Clearly defined incidences that occur during the analytical procedure that makes interpretation difficult or impossible to determine. Examples are turbid cultures without gas production, confluent growth without green sheen, and improper sample analysis.

The Health Division may invalidate positive results in the following circumstances, based on supporting written documentation submitted by the water supplier:

- The repeat sample collected at the same location as the original coliform-present result is also coliform-present and all other repeat samples collected within the five service connections are total coliform-absent. [The Health Division cannot invalidate a coliform-present result simply because all repeat samples are all coliform-absent, or if the system has only one service connection.]
- The Health Division concludes and documents that **substantial grounds** exist to indicate the coliform-present result does not represent water quality in the distribution system (this can rarely be demonstrated).

Note that any invalidated sample can not count toward meeting the minimum monitoring requirements. The water supplier must replace it with an additional valid sample result.

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PUBLIC NOTIFICATION REGULATIONS

by Gary Burnett

EPA published final federal regulations on May 4, 2000 to revise public notification requirements. The revised regulations will apply when states adopt the rule, which states must do by May 6, 2002, to maintain Primacy. We plan to meet that date.

Along with the new rule, EPA and the Association of State Drinking Water Administrators (ASDWA) have issued a Public Notification Handbook to assist water systems in implementing the revised EPA regulation. The handbook provides templates with standard health effects language to help water systems effectively develop and distribute notices. The revised EPA requirements make the standard health effects language more concise, and provide water systems a standard set of procedures to follow. The Drinking Water Program encourages water systems to begin using the new handbook, templates, and standard health effects language now, in advance of the state rule adoption date. Templates for total coliform and fecal/E.coli MCL violations are shown on pages 8 and 9. Note that the templates and standard health effects language are distinctly different for total coliform compared to a fecal/E.coli violation, unlike the current state rule.

Major changes were also made in the timing and methods of providing public notification. The Revised EPA rule classifies violations into 3 “tiers” for public notification purposes:

- **Tier 1**, for violations and situations with significant potential to have serious adverse effects on human health as a result of short term exposure. (Fecal/E.coli, and Nitrate for example). Notice is required within 24 hours of the violation. The current state rule allows 72 hours.
- **Tier 2**, for violations of maximum contaminant levels or treatment techniques which do not pose an immediate threat to human health. (Total coliform, for example). Notice is required within 30 days (or as soon as possible). The current state rule requires newspaper notice within 14 days and notice by mail in 45 days.
- **Tier 3**, for all other violations. Notice is required within 12 months of violation and may simply be included in the next annual Consumer Confidence Report. The current state rule requires notice within three months.

Under the current state rule, water systems are required to use specific multiple delivery methods when distributing notices. The revised EPA rule requires water systems to select a single minimum method for each tier and to take additional steps to reach other persons served (such as schools, apartments etc). The minimum required methods of delivery include the media, hand delivery, or posting for Tier 1 notices, and direct mail, hand delivery, or posting for Tier 2 and Tier 3 notices.

For acute violations, especially boil water advisories, the Division has always encouraged public notice as soon as possible. Consumers can not really make a choice to avoid drinking contaminated water if they receive notice 72 hours after the fact! However,

requirements of the current state rule will remain in effect until the adoption of the revised EPA rule.

The Public Notification Handbook is available from EPA www.epa.gov/safewater/pn.html or by calling the EPA Hotline at (800) 426-4791.

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Source of Walkerton Outbreak (Continued from page 1)

interim membrane filtration system under a comprehensive effort to ensure a safe supply. Walkerton is now pumping a single well (#7) that provides 750 gpm of high quality water from a secure aquifer and expects to bring #6 back into service when it can be treated by the membrane system. The epidemiological report concludes that current approaches to protecting and treating ground water sources need to be re-evaluated given the Walkerton tragedy.

“If we want to prevent this kind of tragedy from occurring again, we have to look at how we protect and treat our municipal water,” said Dr. Murray McQuigge, the unit’s medical officer. “Historically, we’ve always assumed that groundwater sources--deep wells--are secure and therefore only need to be treated with chlorine. This tragedy, which killed six people and made many more sick, is a wake up call that perhaps we need a better system of not only treating municipal water supplies, but protecting them as well.”

McQuigge’s report estimates that although there were 1,346 reported cases of gastroenteritis during the outbreak, the number of people sickened was approximately 2,300.

The hydrology report urged that #5 well be abandoned and that the town establish a wellhead protection area around the other two wells, which tap a deeper source. While investigators found well #7 to be of high quality, they recommended disconnection of an overflow pipe and grouting repairs to a nearby test well as preventive steps. Regarding well #6, which was temporarily closed in August following recurring findings of total coliform, investigators said it draws from a zone that is hydraulically connected to shallow water in a nearby wetland and pond. They recommended plugging some holes in its casing and extending it to water zones below those that are connected to the surface.

The hydrology report will be a major component of a forthcoming final incident report from the Environment Ministry. In a related development, Ontario Attorney General Jim Flaherty this month expanded his initiative to compensate Walkerton residents who were sickened or lost family members. In response to demands from Walkerton, the program will cover other out-of-pocket losses, including lost wages and business losses, and allow those who accept such compensation to file new claims for if they suffer further losses.

Resolved Total Coliform Notice--Template 2-2**IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER**
Tests Showed Coliform Bacteria in [System] Water

Our water system recently violated a drinking water standard. Although this incident was not an emergency, as our customers, you have a right to know what happened and what we did to correct this situation.

We routinely monitor for drinking water contaminants. We took [number] samples to test for the presence of coliform bacteria during [month]. [Number/percentage] of our samples showed the presence of total coliform bacteria. The standard is that no more than [1 sample per month/5 percent of samples] may do so.

What should I do?

- **You do not need to boil your water or take other corrective actions.** However, if you have specific health concerns, consult your doctor.
- People with severely compromised immune systems, infants, and some elderly may be at increased risk. These people should seek advice about drinking water from their health care providers. General guidelines on ways to lessen the risk of infection by microbes are available from EPA's Safe Drinking Water Hotline at 1 (800) 426-4791.

What does this mean?

This is not an emergency. If it had been, you would have been notified immediately. Coliform bacteria are generally not harmful themselves. *Coliforms are bacteria which are naturally present in the environment and are used as an indicator that other, potentially-harmful, bacteria may be present. Coliforms were found in more samples than allowed and this was a warning of potential problems.*

Usually, coliforms are a sign that there could be a problem with the system's treatment or distribution system (pipes). Whenever we detect coliform bacteria in any sample, we do follow-up testing to see if other bacteria of greater concern, such as fecal coliform or *E. coli*, are present. **We did not find any of these bacteria in our subsequent testing, and further testing shows that this problem has been resolved.**

What happened? What was done?

[Describe corrective action.]

For more information, please contact [name of contact] at [phone number] or [mailing address].

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by [system]. State Water System ID#: _____. Date distributed: _____

Fecal Coliform or *E. Coli* Notice--Template 1-2**DRINKING WATER WARNING**

[System] water is contaminated with [fecal coliform/*E. coli*]

BOIL YOUR WATER BEFORE USING

Fecal coliform [or *E. coli*] bacteria were found in the water supply on [date]. These bacteria can make you sick, and are a particular concern for people with weakened immune systems.

What should I do?

- **DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST.** Bring all water to a boil, let it boil for one minute, and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking, making ice, brushing teeth, washing dishes, and food preparation **until further notice**. Boiling kills bacteria and other organisms in the water.
- *Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.*
- The symptoms above are not caused only by organisms in drinking water. If you experience any of these symptoms and they persist, you may want to seek medical advice. People at increased risk should seek advice about drinking water from their health care providers.

What happened? What is being done?

Bacterial contamination can occur when increased run-off enters the drinking water source (for example, following heavy rains). It can also happen due to a break in the distribution system (pipes) or a failure in the water treatment process.

[Describe corrective action.] We will inform you when tests show no bacteria and you no longer need to boil your water. We anticipate resolving the problem within [estimated time frame].

For more information, please contact [name of contact] at [phone number] or [mailing address]. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by [system]. State Water System ID#: _____. Date distributed: _____

HOW TO FILL OUT A LAB SLIP

by Mary Alvey

1. **Public Water System ID#** - enter the ID number for the system being sampled.
2. **Name of Water System** - enter the name of the water system being sampled.
- 3.4. **Address** - enter the address for the water system if it is different than the mailing address.
5. **County** - enter the county where the water system office is located.
6. **Phone** - enter the phone number that the lab should call if they have questions about the sample or if they need to report a positive result.
7. **Collection Date** - enter the date that the sample was collected.
8. **Collection Time** - enter the time that the sample was collected, and circle the AM or PM.
9. **Type of Sample** - mark the appropriate box:
 - Routine - mark this box if the sample is a regular routine sample.
 - Repeat - mark this box if the sample was collected because of a coliform-present routine sample result (see "Date of Initial Positive").
 - Special - mark this box if the test results are for samples collected after disinfecting a new water line or from the water source before treatment. Special samples do not count toward compliance.
10. **Date of Initial Positive** - if the sample was collected as a repeat, then enter the date that the coliform-present routine sample was collected.
11. **Collected By** - enter the name of the person collecting the sample.
12. **Sample Point** - enter a description of the sample location, such as "123 Main St., hose bib" or "Well #2, sample tap."
13. **Chlorinated?** - mark yes if the system is chlorinated, no if it is not.
14. **Free Chlorine** - if the system is chlorinated, use a DPD test kit to measure the free chlorine residual at the site where the sample is collected, and enter the result.
15. **Return Address** - enter the address that the test result is to be mailed to.

Mary Alvey, RS, is Unit Manager of the Monitoring & Compliance Unit of the Drinking Water Program / (503) 731-4381 or mary.b.alvey@state.or.us

Enter Public Water System ID # in boxes below:									
①	4	1	1	2	3	4	5		
Name of Water System:									
②	CRYSTAL CLEAR WATER DIST.								
Address 1234 WATER AVE.									
3/4	City SPRING CITY			⑤	County FALLS				
⑥	Phone 555-1234								
⑦	Collection date and time:		1	/	8	/	01	⑧	10:35
<small>Month Day Year Hour Min p.m.</small>									
⑨	Type of sample: <input type="checkbox"/> Routine <input checked="" type="checkbox"/> Repeat <input type="checkbox"/> Special								
⑩	* If repeat, date of initial positive 1-5-01								
⑪	Collected by: JOE OPERATOR								
⑫	Sample point: 567 MAIN ST., HOSE BIB								
⑬	Chlorinated? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		⑭	Free Chlorine mg/l 0.8					



LABORATORY RESULTS	
Total coliforms:	<input type="checkbox"/> Present* <input type="checkbox"/> Absent
Fecal coliforms/ <i>E. coli</i> :	<input type="checkbox"/> Present* <input type="checkbox"/> Absent
<small>*See back of pink copy for interpretation</small>	
Test Methods:	
<input type="checkbox"/> MTF	<input type="checkbox"/> MF <input type="checkbox"/> P-A <input type="checkbox"/> CF
<input type="checkbox"/> EC	<input type="checkbox"/> EC+MUG <input type="checkbox"/> Nutrient Agar + MUG
Sample invalid: resample immediately	
<input type="checkbox"/> Leaked	<input type="checkbox"/> Over 30 hr old
<input type="checkbox"/> Heavy non-coliform growth (as defined by method)	

⑮	Return address for report: ATTN: JOE OPERATOR
	Name CRYSTAL CLEAR WATER DIST.
	Address PO BOX 999
	City, state, zip SPRING CITY, OR 97123

Copy Distribution:
 White Lab
 Yellow Health Division
 Pink Water System

Form # 50-90 (Rev. 1/98)
 e:\work\labslip

Lab Cert # _____

Sample # _____

Bottle # _____

Date & time received _____

Received by: _____

Date & time analyzed: _____

Comments: _____

Analyst: _____

Review by: _____

BARRIERS TO MICROBIAL CONTAMINATION: THE WALKERTON OUTBREAK

by Dennis Nelson

In May 2000, contamination of a shallow well in Walkerton, Ontario with *E. coli* O157:H7 and *Campylobacter* resulted in six deaths and an estimated 2,300 illnesses in the community (see page 1). The contamination apparently occurred when heavy rainfall washed infected cattle manure into one of the City's wells. The well produced water from a shallow bedrock aquifer that had been thought to be susceptible to bacterial contamination for some time.

The Division has long recognized that proper well construction and maintenance, coupled with a drinking water protection plan, is an effective barrier against the occurrence of a contamination event similar to the one that so severely impacted Walkerton residents. The main tools to achieve this barrier are (1) the plan review process and (2) the Source Water Assessment.

Plan Review

The plan review process is designed to reduce the risk of future contamination by requiring an up-front consideration of well location and construction. An important part of the well construction review is determining the depth of placement of the casing seal (the cement or bentonite that is placed around the casing in the upper part of the well). The Division requires that prior to drilling a well, a water system must submit construction and installation plans to the division for review (OAR 333-061-0060). The Division will review the hydrogeology of the area and make recommendations regarding to what depth the casing seal should extend. Importantly, the casing itself cannot be assumed to provide adequate protection from shallow water gaining access to the well. The casing seal, if properly emplaced, effectively seals off this potentially contaminated water moving down the casing to the aquifer. This is particularly important in a hydrogeologic setting like that at Walkerton, a setting that is also common in Oregon, where a deeper aquifer is overlain by a shallow highly sensitive aquifer. Unless the shallow aquifer is sealed off, the deeper aquifer remains susceptible to contaminated groundwater from shallower depths. For further discussion of well construction issues, see "Plan Review: OHD's Seal of Approval" in the Summer, 1994 PIPELINE.

Source Water Assessments

The 1996 Amendments to the Safe Drinking Water Act require states to conduct Source Water Assessments, with the goal of providing water systems the information needed to develop a drinking water protection strategy. The information provided by the assessment includes (1) the delineation of the drinking water protection area (2)

determination of the potential sources of contaminants within the area, and (3) a determination of the susceptibility of the aquifer to those potential contaminants. The Division partners with the DEQ to provide the assessments to Oregon water systems.

The assessments are being conducted for **all** community, non-transient noncommunity and transient noncommunity water systems. For systems with wells, the delineation identifies the land area above that part of the aquifer that supplies groundwater to the well(s) or spring(s), the inventory recognizes potential sources of pollution within the delineated area, and the susceptibility analysis indicates where the aquifer is sensitive to potential contaminant sources at the surface. The assessment, therefore, provides the water system with real information, based on site-specific data, that relates to how vulnerable their drinking water is to contamination from all sources, including microbiological sources.

Using the assessment data, a water system can develop a drinking water protection plan that is specifically tailored to the system's location and characteristics, and allows for the prioritization of the relative threats of the various potential contaminant sources in their area. Using the assessment data, the water system will be able to develop a specific strategy that is consistent with the type of potential source and the sensitivity of the aquifer in the area.

The Division has completed the delineations for over 320 groundwater-based public water systems in Oregon. Aquifer sensitivity has been determined for over 250 of these systems. This information in itself can aid these water systems in recognizing potential threats and in taking appropriate steps to avoid a disaster similar to the one that struck Walkerton.

More Information

More information about the Source Water Assessment Program is provided in the Summer, 1998 PIPELINE. Water systems with questions regarding source water assessments in Oregon can contact Dennis Nelson of the Division at 541-726-2587. Limited technical assistance is available to water systems to help them develop drinking water protection plans. Water systems with questions regarding this assistance should contact Julie Harvey of DEQ at 503-229-5664.

Dennis Nelson, Groundwater Coordinator, is in the Protection & Development Unit of the Drinking Water Program / (541) 726-2587 or donelson@oregonvos.net



Department of Human Services
 Oregon Health Division
 Drinking Water Program
 P.O. Box 14450
 Portland OR 97293-0450



**PERIODICALS
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TRAINING CALENDAR

Oregon Chapter American Public Works Association

(541) 926-0044
 Feb. 15-16 Construction Inspection
 Mar. 1-2 Project Management

Operator Certification Training

Lisa Vanderpool/(888) 863-8916
 Apr. 16-20 Water Distribution Cert. Review

OCCIRS

Chuck Commiskey/(541) 267-3128
 May 4 Cross Connection Tester Recert.

EWEB Water Management Services

Jeanan Rigney/(541) 984-4747
 Feb. 7 Cross Connection Tester Recert. Preparation
 Feb. 8 Cross Connection Tester Recert.
 Feb. 9 Cross Connection Tester Recert.

Cross Connection/Backflow Courses

Backflow Management Inc. (B)
 (503) 255-1619
 Clackamas Community College (C)
 (503) 657-6958 ext. 2364

Backflow Assembly Tester Course

Mar. 12-16 Portland (B)
 Mar. 19-23 Oregon City (C)

Backflow Assembly Tester Recertification

Feb.5,7,9 Portland (B)
 Feb. 9 Oregon City (C)
 Feb. 22-23 Oregon City (C)
 Mar. 2 Oregon City (C)
 Mar.5,7,9 Portland (B)
 Mar. 10 Oregon City (C)
 Mar. 30 Oregon City (C)

Cross Connection Inspector Course

Feb. 12-15 Corvallis (C)

Cross Connection Inspector Update

Feb. 16 Portland (B)
 Mar. 9 Oregon City (C)
 Mar. 23 Portland (B)

Water System Training Course

Oregon Health Division
 Marsha Fox/(503) 731-4899
 Feb. Linn & Benton Counties
 Mar. Marion County

*Dates and exact locations to be announced

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